

CLAIMS

What is claimed is:

1. A method of measuring a surface strain of a band in a material sheet, the band having a width, the method comprising:

marking a single line traversing the width of the band at an angle before deformation;

deforming the band;

obtaining an equivalent two-dimensional image of the line after deformation;

comparing the line before deformation with the two-dimensional equivalent image of the line after deformation; and

determining the strain in the band after deformation.

2. The method of claim 1, wherein obtaining a equivalent two-dimensional image of the line after deformation comprises:

obtaining plan view and profile view images of the line after deformation; and

performing a three-dimensional to two-dimensional transformation using the plan view and profile view images of the line after deformation.

3. The method of claim 2, further comprising detecting an edge of each of the plan view and profile view images.

4. The method of claim 3, further comprising determining a displacement along the line after deformation.

5. The method of claim 1, wherein deformation includes large-angle bending.

6. The method of claim 1, wherein deformation includes hemming.

7. The method of claim 1, wherein deformation includes flanging.

8. The method of claim 1, wherein marking a single line includes marking a single area having a boundary line.

9. A method of measuring a surface strain of a material sheet; the method comprising:

marking a single straight line traversing a width of a planar band of the sheet an angle;

deforming the sheet such that the planar band becomes a bent band and the straight line becomes a three-dimensional curve;

taking a plan image of the three-dimensional curve on the bent band;

taking a profile image of the bent band;

processing the plan and profile images of the bent band to obtain a two-dimensional curve;

comparing the straight line to the two-dimensional curve; and

determining the strain of the bent band along the two-dimensional curve.

10. The method of claim 9, wherein processing includes detecting an edge of the curve in the plan view and an edge of the bent band in the profile view.

11. The method of claim 10, wherein determining the strain includes obtaining a continuous description of the strain on the bent band.

12. The method of claim 9, wherein the straight band has first and second boundaries and the straight line extends beyond the first and second boundaries.

13. The method of claim 9, further comprising determining a displacement of the bent band the two-dimensional curve.

14. An optical system for measuring a surface strain of a band in a sheet of material after deformation, the system comprising:

a vision system configured to take a plan view image and a profile image of a line traversing a width of the band after deformation, wherein the line is marked on the band before deformation,

an image acquisition system in operable communication with the vision system; and

a computer system in operable communication with the image acquisition system, wherein the computer system includes a digital processing software and a strain calculation software that determine a two-dimensional transformation of the line after deformation, compare the line before deformation to the two-dimensional transformation of the line after deformation, and determine the strain of the bent band.

16. The optical system of claim 15, wherein the vision system includes at least one camera.

17. The optical system of claim 16, wherein the image acquisition system includes edge detection software.